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(56) Documents cited

None

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(54) Telephone operable in a hands-free mode

(57) A telephone operable in a hands-free mode with a desirable acoustic characteristic even when an external speaker 22 is used in place of a built-in speaker 10. On detecting (13, 14) the connection of both of the external speaker 22 and a microphone 21 for hands-free communication, the telephone changes the gain of a variable gain amplifier 15 included in a reception circuit of a hands-free communication circuit 1. The telephone may be mounted on an automobile.

Fig. 2

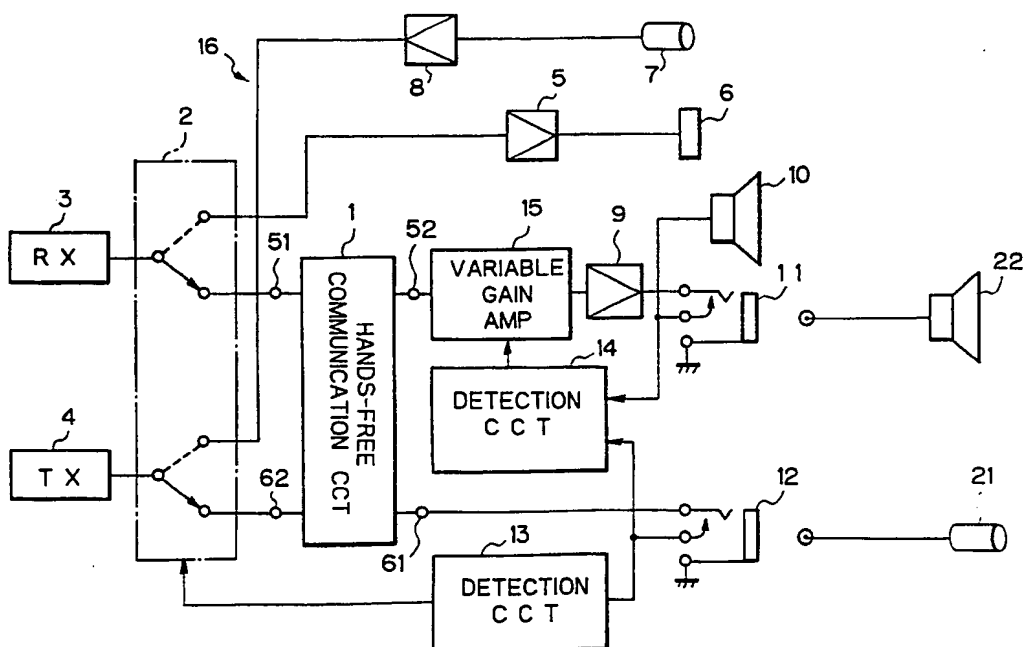


Fig. 1

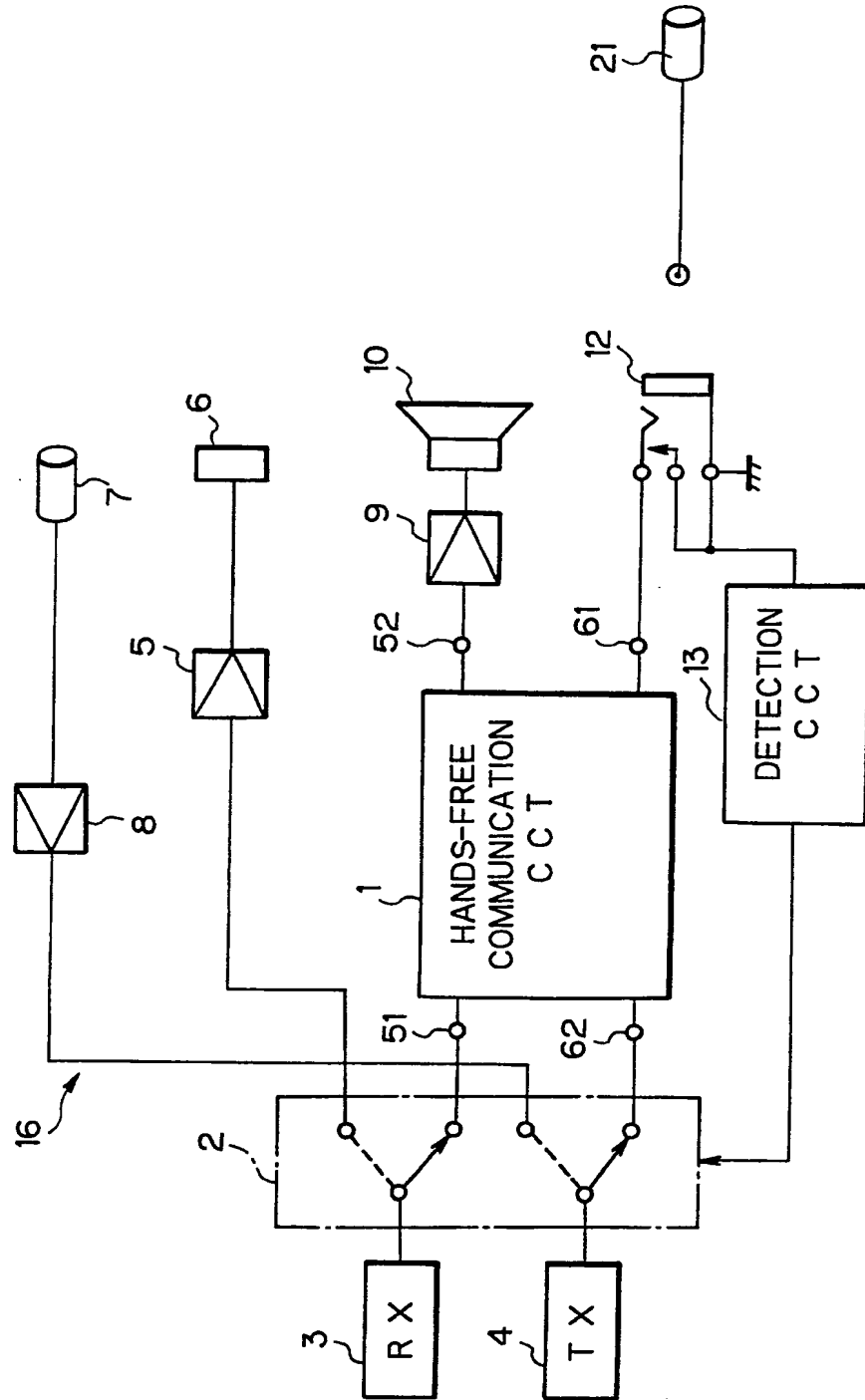
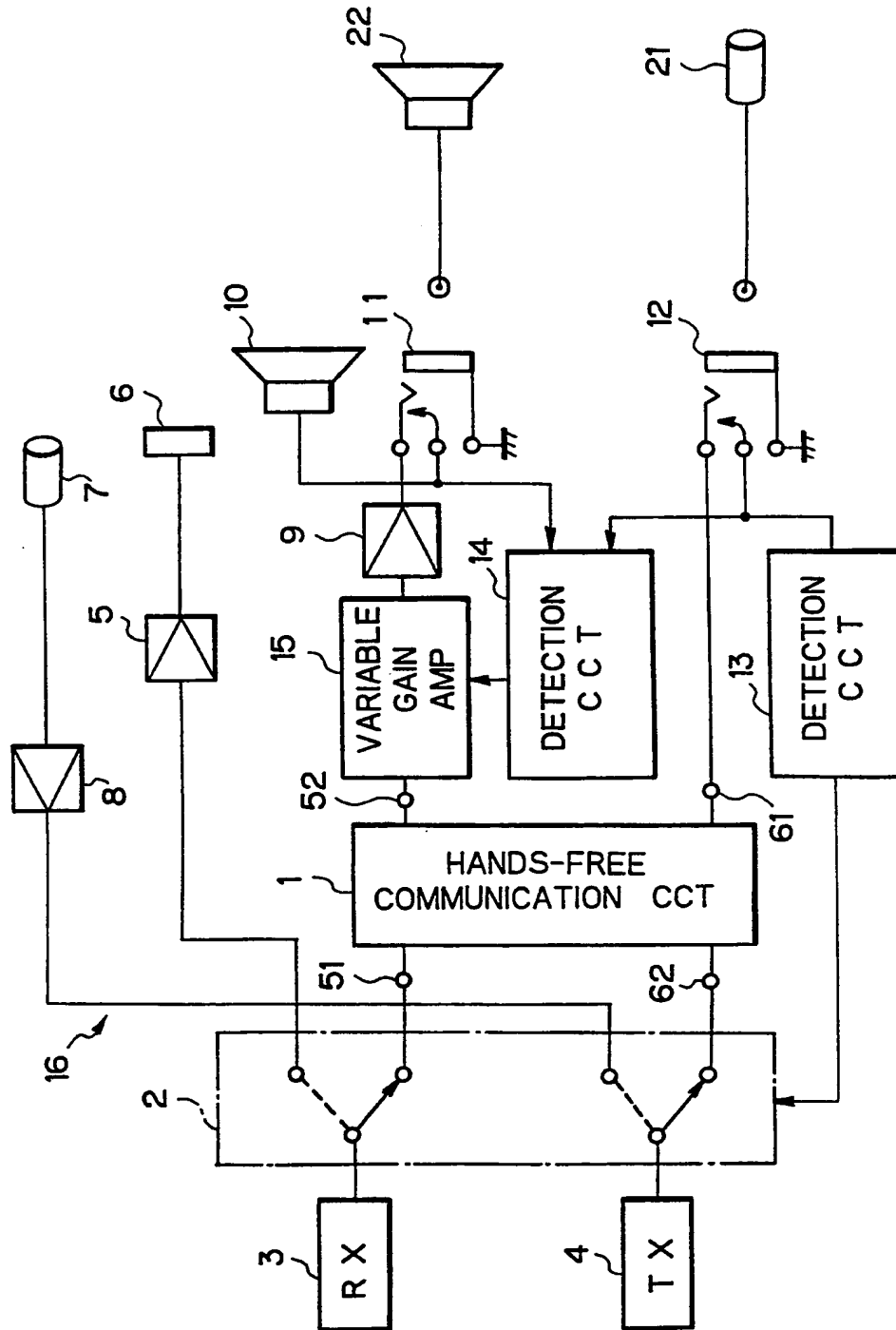


Fig. 2





## TELEPHONE OPERABLE IN A HANDS-FREE MODE

The present invention relates to a telephone operable in a hands-free mode and, more particularly, although not exclusively, to a hands-free telephone mounted on an automobile and including a hands-free communication circuit for allowing the operator to easily hold a  
5 conversation even during driving.

Some modern automobile telephones are operable in two different modes, i.e., an ordinary mode using a microphone and a receiver built in the telephone, and a hands-free mode using  
10 a pull or drag type external microphone and an amplifying section made up of a speaker and a hands-free communication circuit. The hands-free mode promotes easy conversation even when the automobile is driven. A switching device is included in this type of telephone for selecting either of the  
15 two modes, as desired.

In a conventional automobile telephone having a hands-free communication capability, a speaker with high rating and high speaker efficiency cannot be readily accommodated for hands-free communication since the overall size of the  
20 telephone is severely limited. It is, therefore, a common

practice to increase the gain of a speaker amplifier for driving a built-in speaker to thereby insure sufficient sound pressure. However, this is apt to cause voice to saturate and degrades sound quality in the event of hands-free mode communication. Although an extra speaker superior to the built-in speaker in respect of sound pressure and speaker efficiency may be used in place of the built-in speaker, it is apt to cause howling to occur. Therefore, It has been a requisite to effect the hands-free mode communication only through an extra speaker, if needed, and to lower the reception gain in matching relation to the extra speaker. Moreover, the resulting gain distribution makes the sound pressure short when the built-in speaker is used.

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A feature of an arrangement to be described is the provision of a hands-free telephone operable in a hands-free mode with a desirable acoustic characteristic even when an extra speaker is used in place of a built-in speaker.

2 0

A conventional arrangement will now be described, together with an embodiment of the invention given by way of example, with reference to the accompanying drawings in which:

2 5

FIG. 1 is a block diagram schematically showing a conventional automobile telephone having a hands-free communication circuit;

FIG. 2 is a block diagram schematically showing an automobile telephone with a hands-free communication circuit embodying the present invention; and

FIG. 3 is a circuit diagram showing a specific construction of essential part of the embodiment.

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To better understand the present invention, a brief reference will be made to a conventional automobile telephone with a hands-free communication circuit, shown in FIG. 1. As shown, the telephone has a switching circuit 2 for selecting an ordinary communication circuit 16 or a hands-free communication circuit 1. The switching circuit 2 has one common terminal connected to the output terminal of a reception circuit (Rx) 3 and another common terminal connected to the input terminal of a transmission circuit (Tx) 4. Specifically, the output of the reception circuit 3 is routed through the switching circuit 2 to a receiver amplifier 5 which drives a receiver 6. A microphone amplifier 8 is connected to a microphone 7 at the input terminal thereof and connected to the input terminal of the transmission circuit 4 via the switching circuit 2 at the output terminal. The hands-

free communication circuit 1 has a receive input terminal 51 connected to the output terminal of the reception circuit 3 and a receive output terminal 52 connected to the input terminal of a speaker amplifier 9 which drives a speaker 10. Further, this circuit 1 has a transmit output terminal 62 connected to the input terminal of the transmission circuit 4 via the switching circuit 2 and a transmit input terminal 61 connected to a jack 12. The jack 12 allows an extra microphone 21 for hands-free communication to be connected thereto, as desired. A detection circuit 13 determines whether or not the extra or hands-free microphone 21 is connected to the jack 12, thereby generating a control signal for operating the switching circuit 2.

In operation, when the hands-free microphone 21 is not connected to the jack 12, the ordinary communication mode is set up, i.e., the switching circuit 2 is held in a condition indicated by phantom lines in FIG. 1. In this configuration, a conversation can be held on the microphone 7 and receiver 6. Voice entered via the microphone 7 is amplified by the microphone amplifier 8, inputted to the transmission circuit 4 via the switching circuit 2, and then sent to a remote station. A received signal is delivered from the reception circuit 3 to the receiver amplifier 5 via the switching circuit 2. The resulting amplified signal drives the receiver 6.



Referring to FIG. 2, a hands-free telephone embodying the present invention is shown which is also implemented as an automobile telephone by way of example. In the embodiment, the same or similar constituents to those of the conventional telephone are designated by like reference numerals. As shown, the telephone includes a hands-free communication circuit 1 having a receive output terminal 52 connected to a variable gain amplifier 15. The output of the variable gain amplifier 15 is connected to a speaker amplifier 9. The output of the speaker amplifier 9 is connected to a built-in speaker 10 via a jack 11 adapted to receive an extra or external speaker 22. A detection circuit 14 determines whether or not the extra speaker 22 is connected to the jack 12 and whether or not an extra or hands-free microphone 21 is connected to a jack 12, thereby generating a control signal for changing the gain of the amplifier 15.

The operation of the embodiment will be described hereinafter. The following description will concentrate on the hands-free mode communication since the ordinary mode communication is identical with that of the conventional telephone.

Assume that the hands-free microphone 21 is connected to the jack 12 as determined by the detection circuit 13. Then, a switching circuit 2 is conditioned as indicated by solid lines in FIG. 2 by the resulting output of the detection

circuit 13. In this configuration, incoming and outgoing speeches both are routed through the hands-free communication circuit 1, i.e., a hands-free communication is held on the built-in speaker 10 and hands-free microphone 21.

5 In the illustrative embodiment, a particular gain is allocated to each of the variable gain amplifier 15 and speaker amplifier 9 beforehand such that an optimal gain distribution is set up when the built-in speaker 10 is used. This insures desirable hands-free communication.

10 When the extra speaker 22 is connected to the jack 11, the output of the speaker amplifier 9 is brought into connection with the speaker 22. On detecting the connection of the speaker 22 and the microphone 21 to the jacks 11 and 12, respectively, the detection circuit 14 changes the gain of  
15 the amplifier 15 to set up the optimal gain distribution stated above. This is successful in effecting a hands-free communication with desirable sound quality despite the use of the external speaker 22.

20 FIG. 3 shows a specific construction of the detection circuit 14, variable gain amplifier 15, etc. As shown, the variable gain amplifier 15 is made up of an analog switch 31, and an operational amplifier 32 whose gain is determined by resistors 41, 42 and 43. The detection circuit 14 is constituted by a NOR gate 33 and bias resistors 44 and 45.

The jack 11 for receiving the extra speaker 22 is implemented by one adapted for a stereo unit.

Referring to FIG. 3, assume that the hands-free microphone 21 is connected to the jack 12 to effect a hands-free mode communication. Then, one input 35 of the NOR gate 33 turns from a high level to an open state since a voltage +V having been applied via the bias resistor 45 is shut off. While the built-in speaker 10 is used, the other input 34 of the NOR gate 33 remains in a high level since the voltage +V is applied via the bias resistor 44. Hence, the output of the NOR gate 33 is in a low level. At this instant, the analog switch 31 is held in a condition indicated by a solid line, so that the gain of the variable gain amplifier 15 is determined by the resistors 41 and 43. This sets up a gain distribution matching the built-in speaker 10. As the extra speaker 22 is connected to the jack 11, the output of the speaker amplifier 9 is disconnected from the built-in speaker 10 and connected to the external speaker 22. Since the input 34 of the NOR gate 33 becomes open, the output of the NOR gate 33 goes high. At this instant, the analog switch 31 is conditioned as indicated by a phantom line with the result that the gain of the amplifier 15 is determined by the resistors 42 and 43. This sets up a gain distribution matching the external speaker 22.

In summary, it will be seen that there has been described a hands-free telephone operable with a desirable

acoustic characteristic in a hands-free mode with no regard to the kind of a speaker, i.e., a built-in speaker or an extra speaker. This unprecedented advantage is derived from the fact that, on detecting the connection of both of an extra  
5 speaker and a hands-free microphone, the telephone changes the gain of a variable gain amplifier included in a reception circuit of a hands-free communication circuit.

Various modifications and variations will become possible for those skilled in the art after receiving the teachings of the present  
10 disclosure without departing from the scope thereof,  
as defined in the appended claims.

CLAIMS

- 1           1. A hands-free telephone operable in a hands-free mode  
by using a built-in speaker for hands-free communication and  
a microphone for hands-free communication, comprising:  
            microphone connecting means for connecting the  
5      microphone for hands-free communication;  
            speaker connecting means for connecting an extra  
speaker;  
            detecting means for determining a connection condition  
of said microphone connecting means and a connecting  
10     condition of said speaker connecting means; and  
            gain feeding means for feeding a gain matching the extra  
speaker to said extra speaker when said detecting means has  
determined that said microphone connecting means and said  
speaker connecting means are each in a connected condition.
- 15           2. A telephone as claimed in claim 1, wherein said gain  
feeding means comprises a variable gain amplifier for feeding  
a gain distribution matching each of the built-in speaker and  
the extra speaker.
3. A telephone as claimed in claim 1, wherein said  
20     variable gain amplifier comprises an operational amplifier  
and resistors for determining a gain of said operational  
amplifier.
4. A telephone as claimed in claim 1, wherein said  
detecting means comprises a NOR gate and bias resistors.

5. A telephone as claimed in claim 1 including an arrangement substantially as described herein with reference to either Fig. 2 or Fig. 3 of the accompanying drawings.

- 12 -

**Patents Act 1977**  
**Examiner's report to the Comptroller under**  
**Section 17 (The Search Report)**

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**Relevant Technical fields**

- (i) UK Cl (Edition L ) H4K KBHB, KBHX, KYX
- (ii) Int Cl (Edition 5 ) H04M; H04Q

Search Examiner

MR M J JONES

**Databases (see over)**

- (i) UK Patent Office
- (ii) ONLINE DATABASE: WPI

Date of Search

11 JANUARY 1993

Documents considered relevant following a search in respect of claims 1-5

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s).

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**Y:** Document indicating lack of inventive step if combined with one or more other documents of the same category.

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**E:** Patent document published on or after, but with priority date earlier than, the filing date of the present application.

**&:** Member of the same patent family, corresponding document.

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